TOPCON

REPAIR MANUAL

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REVISED ····

SLIT LAMP

SL-6E

TOKYO OPTICAL CO., LTD.

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CONTENTS

1. Introduction ---------- 1
1.1 Features ---------- 1
1.2 Users of this manual ---------- 2
1.3 Using this manual and precautions ---------- 2
1.3.1 Precautions for repairs ---------- 2
1.3.2 Repairing procedure ---------- 3
1.4 Part names ---------- 4
1.5 Optical arrangement ---------- 6
1.6 Electrical circuit (for standard export models)--- 8
(for USA models) ---------- 9
(for Europe models) ---------- 10
2. Guide to Repair ---------- 11
2.1 Accuracy checks ---------- 11
2.2 Adjustment ---------- 13
2.2.1 Microscope unit ---------- 13
(1) Focus setting ---------- 13
(2) Optical axis setting ---------- 15
(3) Accuracy setting of pupillary distance adjusting prism box ---------- 17
2.2.2 Illumination unit ---------- 18
(1) Adjustment of slit width adjusting knob ---------- 18
(2) Adjustment of inclination power ---------- 18
(3) Center setting of aperture and slit image ---------- 19
(4) Slit image shift setting when rotating the slit image ---------- 20
(5) Focus setting of slit image ---------- 21
(6) Slit image shift setting when rotating the slit illumination unit horizontally (30° to the left and right) ---------- 22
(7) Slit image shift setting when inclined ---------- 23
(8) Click power of small and large arms ---------- 24
(9) Inclination of slit image ---------- 25

2.3 Repairing Order ---------- 26
Precautions for repairs ---------- 26
2.3.1 Disassembling order of microscope unit --------- 27
(1) Removing microscope unit ---------- 27
(2) Removing magnification change knob ---------- 27
2.3.2 Critical points for assembling microscope unit ---------- 28
(1) Adjustment of magnification change knob looseness ---------- 28
2.3.3 Disassembling order of illumination unit ------- 29
(1) Removing slit lamp unit ---------- 29
(2) Removing aperture and filter unit ---------- 29
2.3.4 Critical points for assembling illumination unit ---------- 30
(1) Slit lamp unit ---------- 30
(2) Unsmooth or unevn control of adjustment knob of slit length and filter units ---------- 32
2.3.5 Cause and remedy for main possible trouble ----- 33
2.4 List of repair tools ---------- 34

1. Introduction

The basic construction of this instrument is almost the same as SL-5D, but has been improved for better handling, greater convenience and durability.

1.1 FEATURES

1.1.1

With the previous models, fusion was rather difficult for those used to the Galileo model, but this model has been improved for better view by adopting convergent binocular tubes. Additionally, without changing eyepiece, 5 steps of magnification are available with this model (SL-5D: 3 steps).

1.1.2

The shape and material of operation units has been changed so that better handling, greater convenience and durability are realized.

1.1.3

Both the elevation and horizontal positioning of the instrument are possible with one over, which makes it easier to operate.

1.1.4

Table appearance has been enhanced with the corners being rounded so as to prevent injury if contacted.

1.1.5

The position of the height marker has been lowered. And incorporating other equipment has become easier using the sliding table.

New SL-6E's features not provided by SL-5D are as above.

1.2 Users of this manual

This is optical equipment designed for ophthalmic testing. This manual is intended mainly for those experienced in handling optical instruments, such as making repairs and adjustments. If you have no experience of such, it is necessary to take the short repair course sponsered by TOPCON.

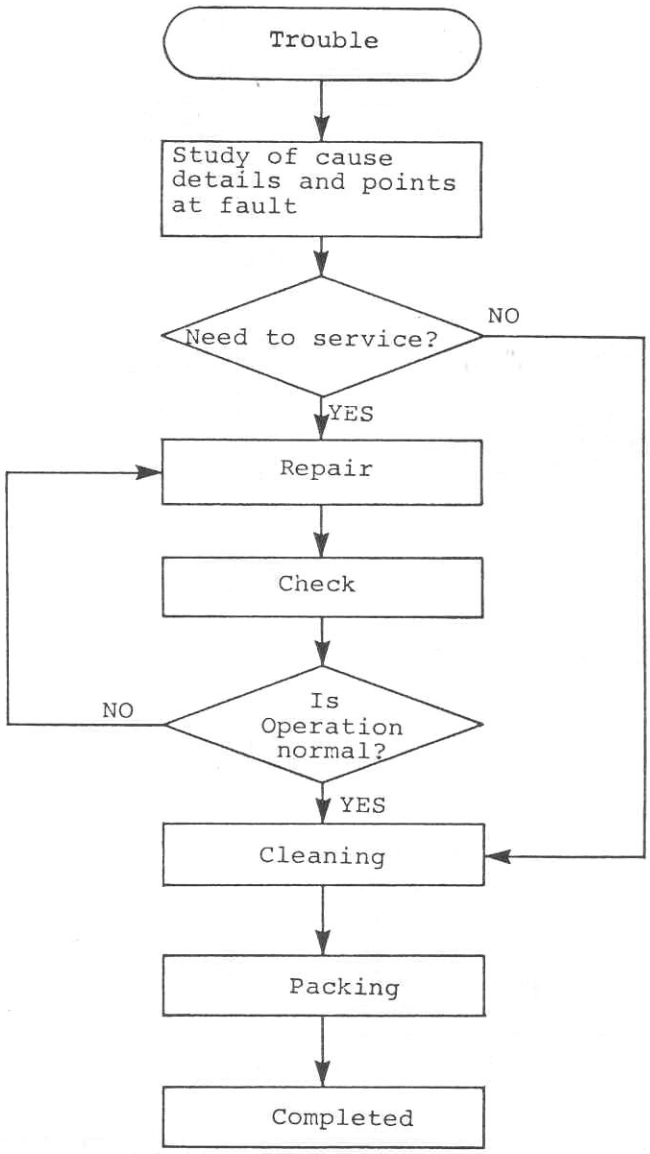
1.3 Using this manual and precautions

1.3.1 Precautions for repairs

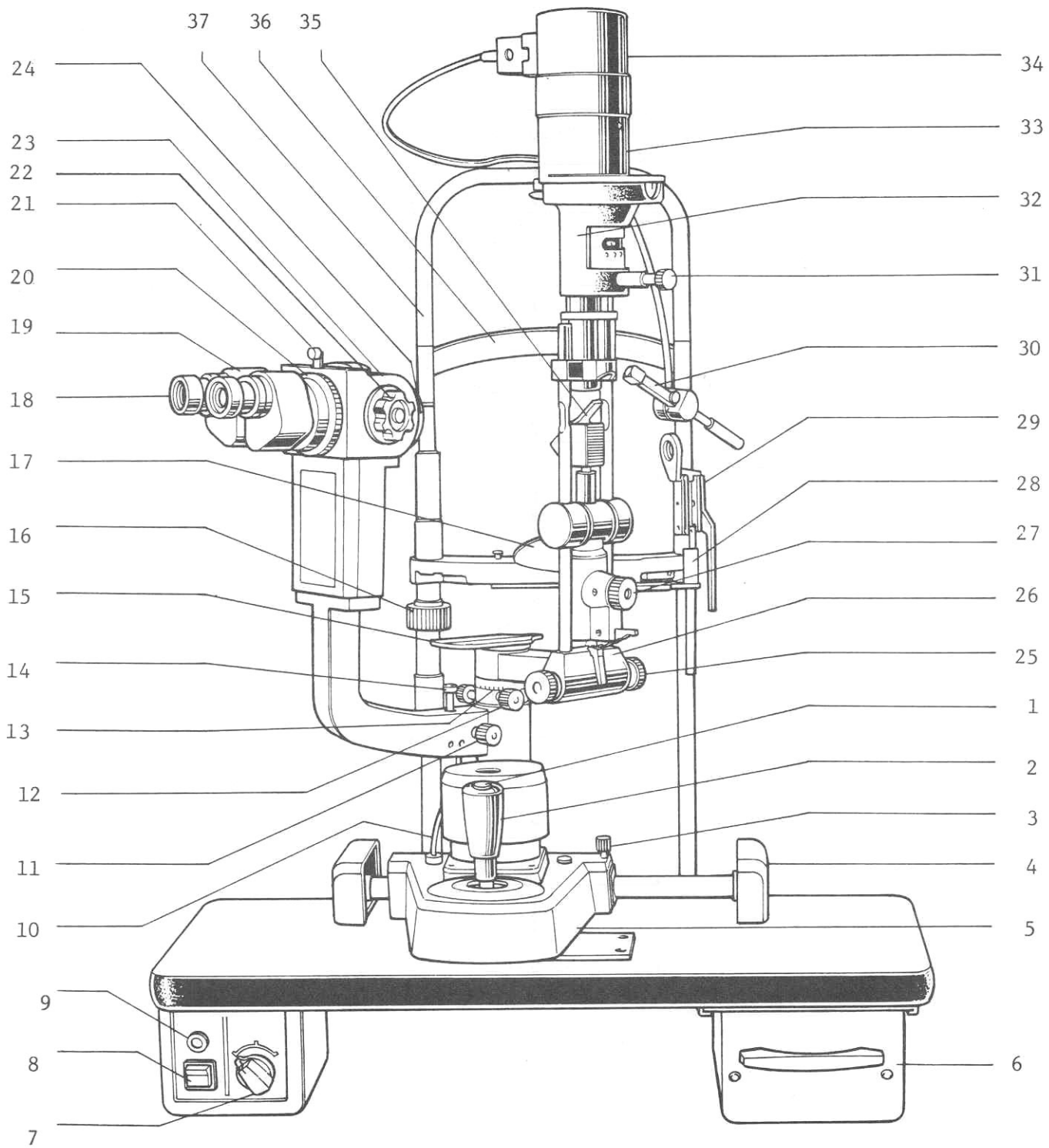
(1) Carry out repairs for optical system in the clean area where no dust or foreign matter will affect instrument performance.
(2) Regarding how to assemble and check, refer to the SL-6E assembly and instruction manuals.
(3) Always carry out repairs according to the instructions of this manual, especially using the specified material and tools.
(4) Instructions in this manual are on the basis that metal items must be changed one-by-one and optical components by units.
(5) Refer to the parts list for disassembling and assembling of those parts not described in this manual.
(6) Never use any grease or sealant except those specified in this manual.
(7) Order the parts, if required, according to the name and numbers used in the service parts list.

1.3.2 Repairing procedure

Follow the procedures described in the flowchart below.



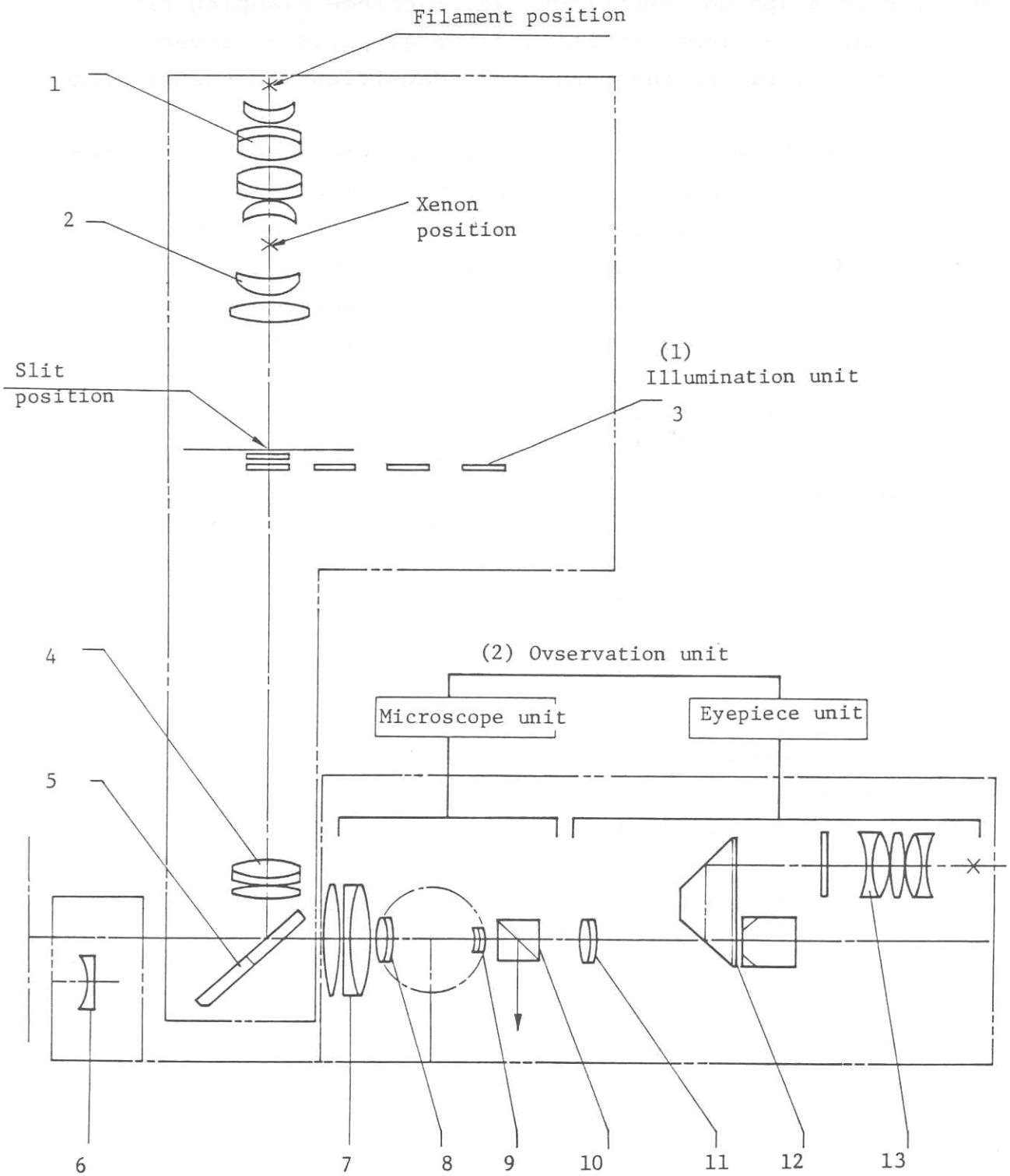
1.4 Part names



1. Photographing pushbutton
2. Omni-directional joystick
3. Cross slide fixing screw
4. Rail cover
5. Cross slide
6. Accessory drawer
7. Brightness control dial
8. Power source switch
9. Pilot lamp
10. Connecting cable for microscope
11. Microscope arm fixing screw
12. Illumination arm fixing screw
13. Angle scale
14. Click stop roller
15. Hruby lens guide plate
16. Chin-rest adjusting knob
17. Chin-rest
18. 12.5X magnification eyepiece
19. Microscope binocular eye-piece
20. Eyepiece clamping ring
21. Beam splitter lever
22. Magnification change knob
23. Microscope optical system
24. Objective lens
25. Slit width adjusting knob
26. Inclination unit
27. Slit centering control
28. Hruby lens holder
29. Hruby lens
30. Fixation target
31. Slit length adjustment knob
32. Aperture and filter unit
33. Slit illumination unit
34. Lamp house
35. Mirror
36. Head rest
37. Height lever marker

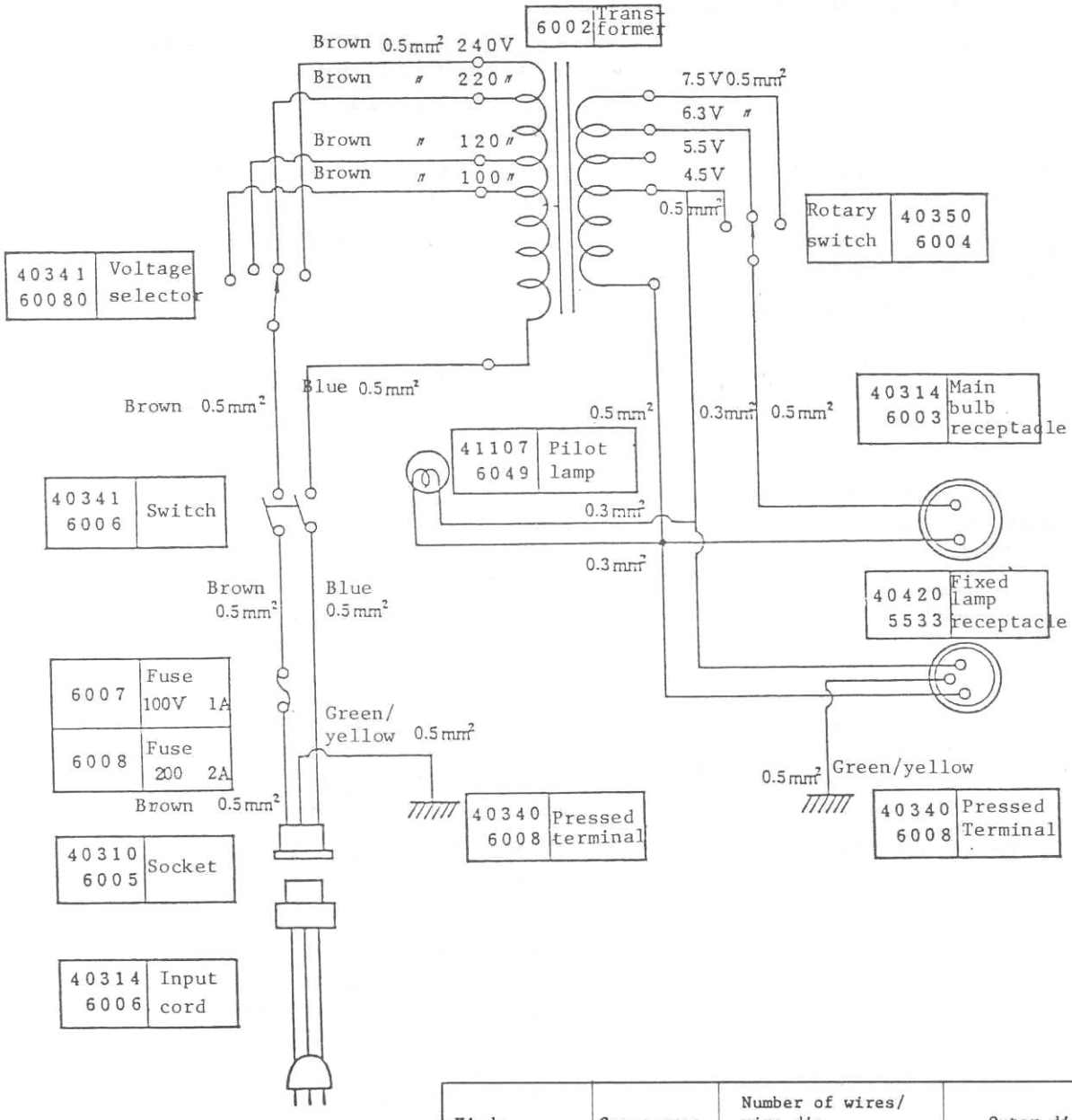
Note: For their function, refer to instruction manual.

1.5 Optical arrangements



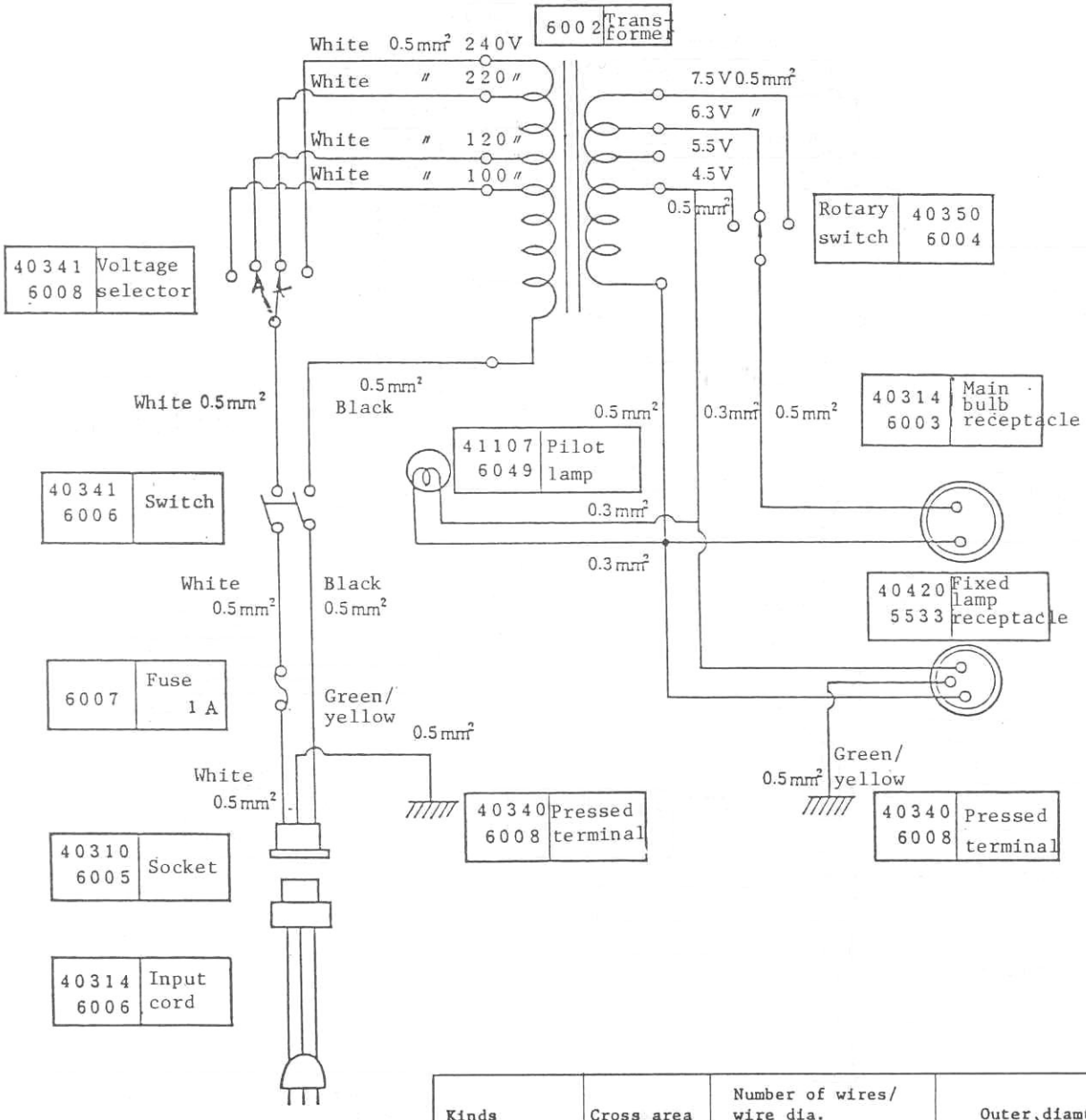
Names of optical unit	Kind of modulations
(1) Condenser lens (when photographing unit mounted)	Attach it to use photographing unit. Condensing positioning is to be made for main filament bulb
(2) Condenser lens for main filament bulb	Condenser requires positioning
(3) Filter	Select cobalt blue, red-free, 13% neutral density, heat absorbing filter according to purposes
(4) Projection lens	Projects and focuses slit images
(5) Reflection mirror on front portion of eye or focusing rod).	Reflect slit image to bring it
(6) Hruby lens	Use for making fundus observations
(7) Objective lens of microscope	
(8) Fixed objective lens for Magnification system	
(9) Objective lens for magnification system	Focuses observed image in magnification system microscope and aligns it with optical axis
(10) Beam splitter lens	Use with photographing unit. Prism to conduct light path from microscope to eyepiece lens and camera
(11) Objective lens in eyepiece	Focuses observed image in eyepiece and aligns it with optical axis
(12) Erecting prism	Change observed image in microscope from inverted to erect and adjusts rotation centering axis so as to prevent image from moving even by pupillary shift
(13) Eyepiece lens	Adjust diopter to patient's eyes by increasing eyepiece magnification

1.6 Electrical circuit (For standard export models)



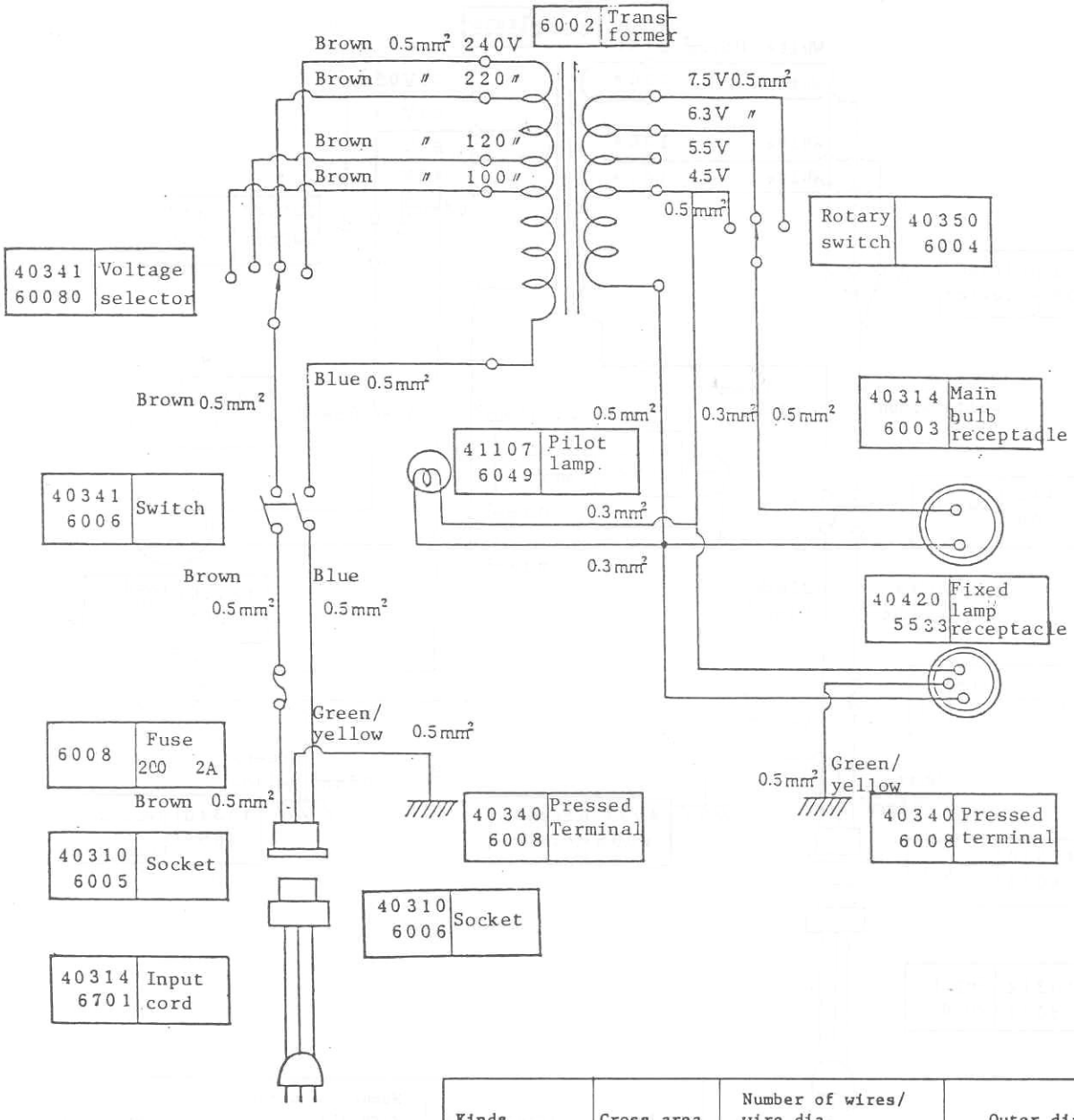
Kinds	Cross area	Number of wires/ wire dia.	Outer diamter
White, Black, yellow/ green	0.5 mm^2	20/0.18 mm	2.5 ϕ
Color for primary and other colors than brown and blue	0.5 mm^2	20/0.18 mm	2.5 ϕ
	0.3 mm^2	12/0.18 mm	1.4 ϕ

1.6 Electrical circuit (For U.S.A models)



Kinds	Cross area	Number of wires/ wire dia.	Outer diamter
White, Black, yellow/ green	0.5 mm²	20/0.18 mm	2.5 ϕ
Color for primary and other colors than brown and blue	0.5 mm²	20/0.18 mm	2.5 ϕ
	0.3 mm²	12/0.18 mm	1.4 ϕ

1.6 Electrical circuit (For Europe models)



Kinds	Cross area	Number of wires/ wire dia.	Outer diamter
White, Black, yellow/ green	0.5 mm^2	20/0.18 mm	2.5 ϕ
Color for primary and other colors than brown and blue	0.5 mm^2	20/0.18 mm	2.5 ϕ
	0.3 mm^2	12/0.18 mm	1.4 ϕ

2. Guide to repair

2.1 Accuracy checks

1. Microscope

<table>
<tr><th>NO.</th><th>Item</th><th>How to check and allowance</th><th>How to adjust and repair</th><th>Tools</th></tr>
<tr><td>(1)</td><td>Image shift due to magnification</td><td>Place the standard scale on the object and measure it using eyepiece with scale (Within 0.25 mm, standard: 16x)</td><td>See page 15 Optical axis setting of microscope</td><td>Standard scale[3] Eyepiece with scale [2]</td></tr>
<tr><td>(2)</td><td>Same focusing due to magnification</td><td>Focus at 25.6x total magnification and change the objective to 40x, 16x and 10x to focus, then measure the difference. (Should be within 0.5 D and 0.2mm at 12x magnification)</td><td>See page 13 Focus setting of microscope</td><td>Diopter telescope</td></tr>
<tr><td>(3)</td><td>Parallelity of right and left optical axis</td><td>Place the standard side on the object plane and check the difference of axis using eyepiece with scale
<table><tr><th>Indicated Magnification</th><th>Height difference 20'</th><th>Inward 50'±25'</th></tr><tr><td>6 x</td><td>less than 0.24</td><td>0.3 to 0.88mm</td></tr><tr><td>10 x</td><td>less than 0.15</td><td>0.18 to 0.54 mm</td></tr><tr><td>16 x</td><td>less than 0.09</td><td>0.12 to 0.34 mm</td></tr><tr><td>25 x</td><td>less than 0.06</td><td>0.07 to 0.21 mm</td></tr><tr><td>40 x</td><td>less than 0.04</td><td>0.05 to 0.13 mm</td></tr></table>* Inward right and left should be distributed evenly.
* The above table is applied when setting the beam splitter at IN position.</td><td>See page 15 Optical axis setting of microscope</td><td>Standard scale[3] Eyepiece with scale [2]</td></tr>
<tr><td>(4)</td><td>Image shifts when adjusting the pupillary distance</td><td>Place the standard scale on the object side. Set pupillary distance at minimum then maximum distance and measure the maximum shift width of axis.
* within 0.05mm</td><td>See page 17 Accuracy setting of pupillary distance prism box</td><td>Standard scale[3] Eyepiece with scale[2]</td></tr>
</table>

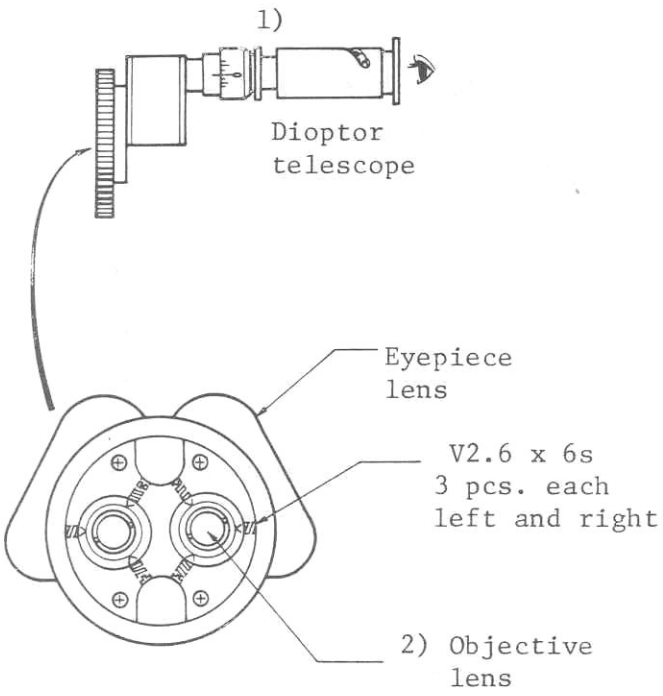
2. Illumination Unit

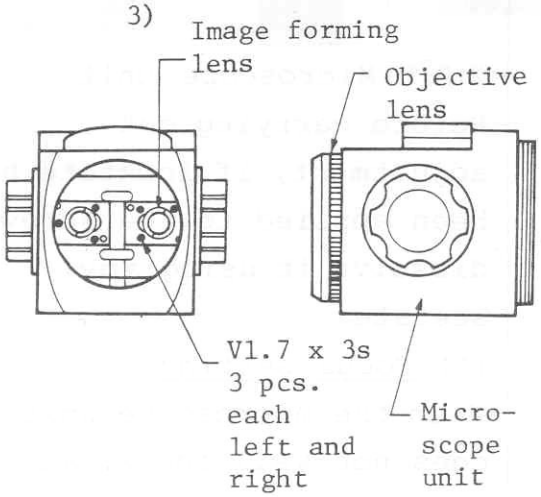
NO.	Item	How to check and allowance	How to adjust and repair	Tools
(1)	Slit width narrows by itself	When changing slit with, power of knob is too weak to ensure it at the desired position.	See page 18 Adjustment of slit width adjusting knob	
(2)	When releasing inclination unit, it inclined too quickly	Check if slit illumination inclines too quickly when removing stopper to incline slit illumination.	See page 18 Adjustment of inclination power	

NO.	Item	How to check and allowance	How to adjust and repair	Tools
(3)	Difference between aperture and slit image	Measure the difference of the center in the open/close direction of slit. (At 0.5mm dia.: less than 0.05mm At 3mm and 12mm dia.: less than 0.1mm)	See page 19 Center setting of aperture and slit image	Eyepiece with scale [2]
(4)	Slit image shifts after slit rotated	Set the slit size at 0.1mm aperture and project the slit image on the focusing rod. After rotated a slit, measure the maximum moved distance of slit image. (After rotate the slit from vertical to horizontal position: within 0.1mm)	See page 20 Slit image shift setting when rotating the slit image	Standard scale [3] Eyepiece with scale [2]
(5)	Slit image is out of focus	Even after correcting diopter setting of microscope, a slit image is still out of focus.	See page 21 Focus setting of slit image	
(6)	Slit image shifts after rotating the slit lamp unit (30° to the left and left horizontally)	Rotate the lamp arm horizontally 30° and measure the shifted distance of slit image. (Within 0.1mm)	See page 22 Slit image shift setting when rotating the slit lamp unit horizontally	Standard scale[3] Eyepiece with scale [2]
(7)	Slit image shifts when inclining illumination unit	Release inclination Lock lever and incline illumination unit, then, measure the shifted distance of slit image. At 0 to 20° inclination, distance should be within 0.05mm.	See page 23 Adjustment of slit image shift setting when inclined	Standard scale[3] Eyepiece with scale[2]
(8)	Trouble of click power of small and large arms	Check to click power by placing small and large arms at stops on the same line.	See page 24 Adjustment of click power of small and large arms	
(9)	Inclination of slit image	Project a slit image on focusing rod and measure the degrees of inclination of slit image (at point of click, vertical: within 1°, at point of 12mm slit length: within 0.21mm)	See page 25 Adjusting inclination of slit image	Focusing rod

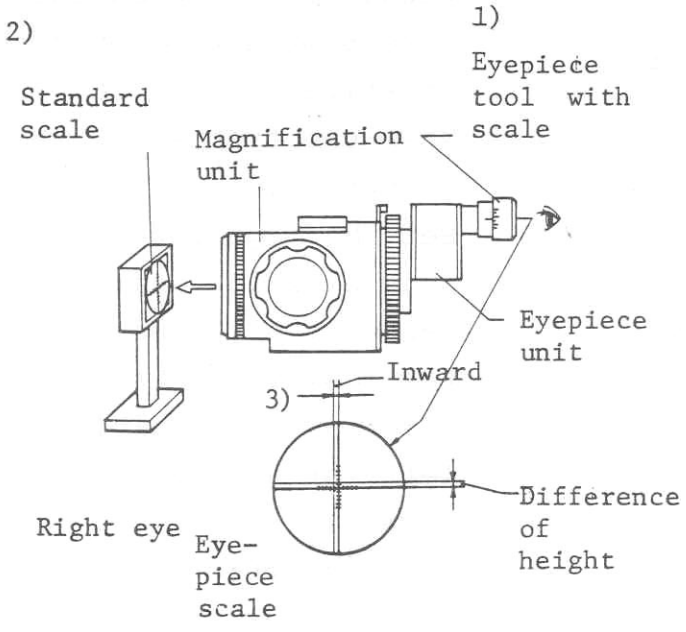
Note: The width of a line provided on the eyepiece with scale is 0.02mm. When checking the accuracy, use this value as a guideline.

2.2 Adjustment

Sketch	Procedure
	2.2.1 Microscope unit Before carrying out adjustment, if locktite has been applied to the screw, dissolve it using amyl acetate. (1) Focus setting When the microscope unit does not well focus, and the slit image is not clear (with magnification drum unit at 16x): 1) Remove eyepiece unit. Place the diopter telescope on top of the eyepiece unit, then sight a target as far away as possible to check for diopter zero setting. The '0' on diopter adjustment ring scale should be at the zero marker with 0.5 diopter allowance. 2) Adjust the objective lens frame (1501) so that the finest focusing is obtained at the '0 diopter' on the scale. Finally, apply locktite.

Sketch	Procedure
3)  	3) Mount the eyepiece unit on the magnification unit. Turn the magnification unit clamp ring clockwise to couple the eyepiece unit with the magnification unit, then set the magnification drum at 25.6x and 40x respectively for setting focus, by moving the focusing lens frames (1013) and (1016) back and forth. 4) Apply locktite after setting focus.

Sketch	Procedure



Direction	Optical axis balancing	Material dimensional conversion (mm)				
		6 x	10x	16x	25x	40x
High and low	within 20'	within 0.24	within 0.15	within 0.09	within 0.06	within 0.04
Inward	50' ± 25'	0.59 ±0.29	0.36 ±0.18	0.23 ±0.11	0.14 ±0.07	0.09 ±0.04

(2) Optical axis setting

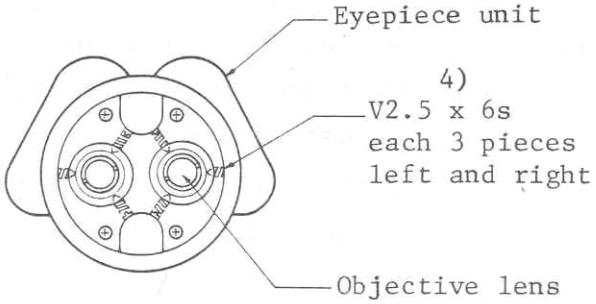
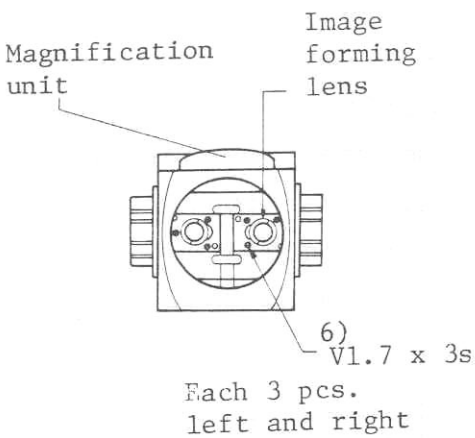
1) Put eyepieces with scale on the eyepiece unit and turn the draw tube to adjust diopter.

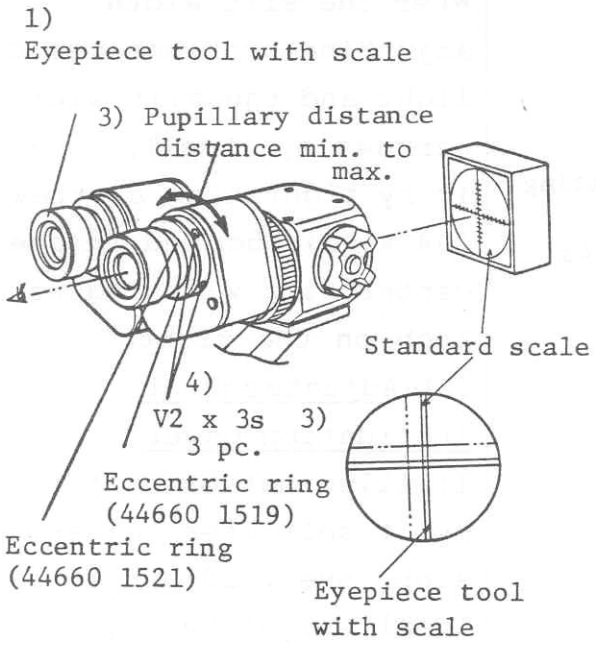
2) Project a slit as narrow as possible (length: 9mm) on the standard scale.

3) Find which is wrong, magnification unit or eyepiece unit.
Set magnification drum at 16 x where no lens is set. Then check the difference of images between when placing the slit vertically and horizontally to determine that eyepiece is correctly adjusted.

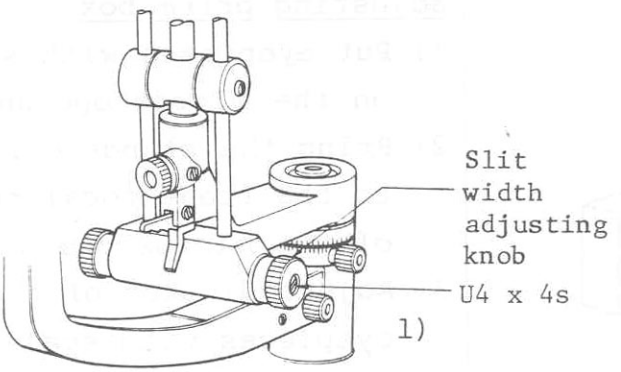
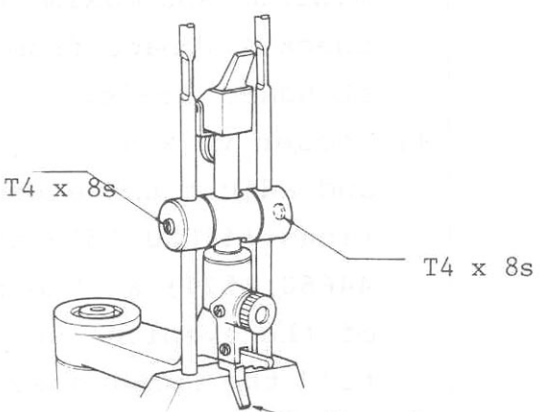
Slippage optical axis-
difference in height:
within 0.04mm
Difference in height
between two eyepieces:
within 0.045mm
Inward slant: within
0.15mm
Inward slant between two
eyepieces: within 0.23mm

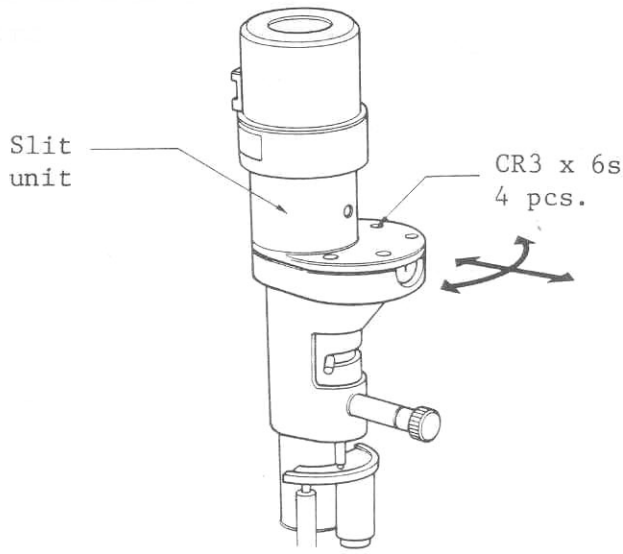
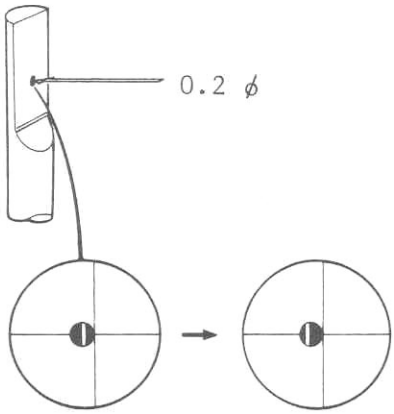
4) When something is wrong with the eyepiece unit: Use V2.6 x 6s, 3 pc. each on left and right sides, to move the objective lens frame (1501) to adjust the slippage within the

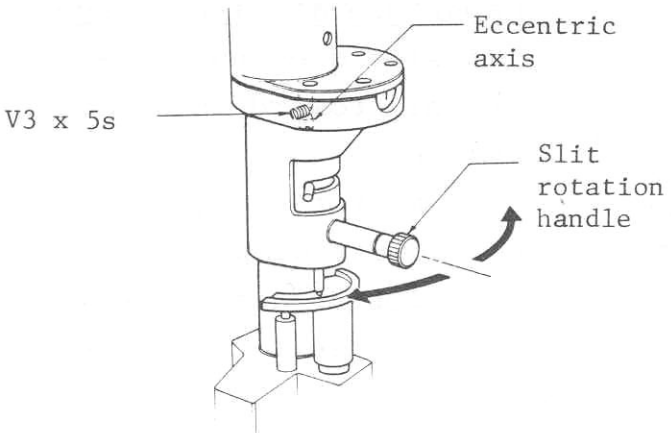
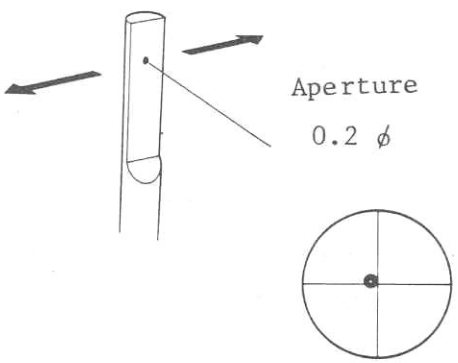
Sketch	Procedure
 	standard. Tighten the screws well and apply locktite. 5) When the eyepiece unit is normal: Set the magnification unit at 25.6x and 40x respectively, and give the same checks as in (3) above. See table at left for slippage levels. 6) When something is wrong with magnification unit: Carry out adjustment so that magnification system matches with the standard: adjust image forming lens frames (1013 and 1016) of 40x and 25.6 x using 3 screws, v17 x 3s. After adjustment, tighten screws firmly and apply locktite.

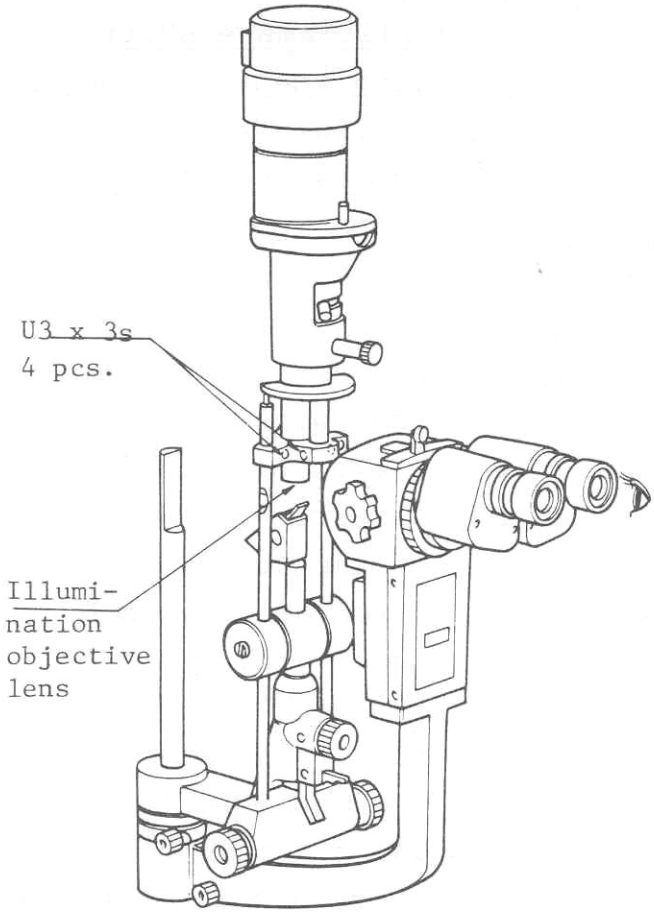
Sketch	Procedure
 Image movement: within 0.05mm	(3) Accuracy setting of pupillary distance adjusting prism box 1) Put eyepieces with scale on the microscope unit. 2) Bring the standard scale to the front focal point of the microscope unit. 3) Adjust diopter of the eyepieces with scale, and move the pupillary distance prism box to minimum and maximum to check slippage from the standard scale. 4) Loosen V2 x 6s, 3 pc., and adjust the eccentric rings (44660 1519 and 44660 1521) at the base of the eyepiece unit till the image does not move while moving the pupillary distance prism box to minimum and maximum (on both sides) 5) Tighten well V2 x 3s, 3 pc. after accuracy setting.

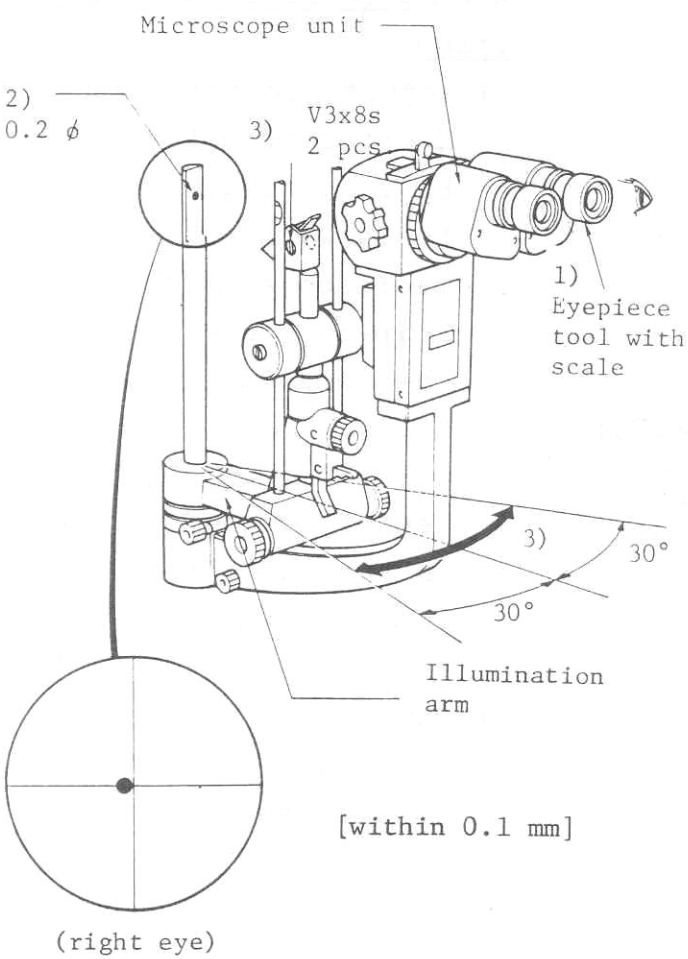
2.2.2. Illumination unit

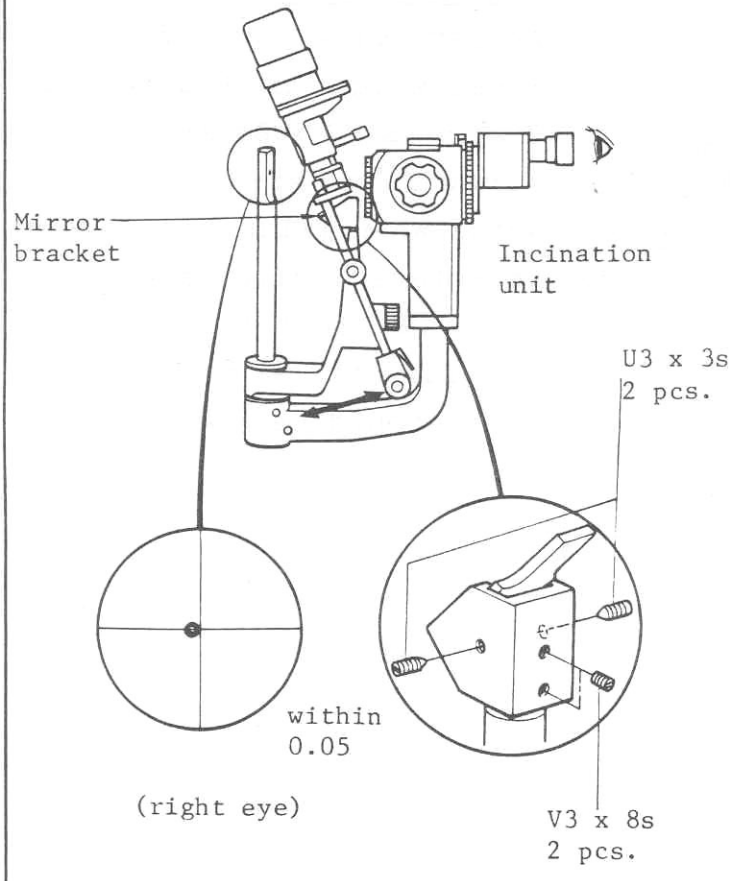
Sketch	Procedure
  [1,000 - 1,400g]	(1) Adjustment of slit width adjusting knob When the slit width adjusting knob becomes too light and the slit width narrows by itself, adjust it by tightening a screw (U4 x 4s) located in the center slit width adjusting knob on the right. (2) Adjustment of inclination power If illumination unit falls by it self when releasing stop lever, adjust it for ideal weight by tightening 2 screws T4 x 8s on the both sides of rotating unit.

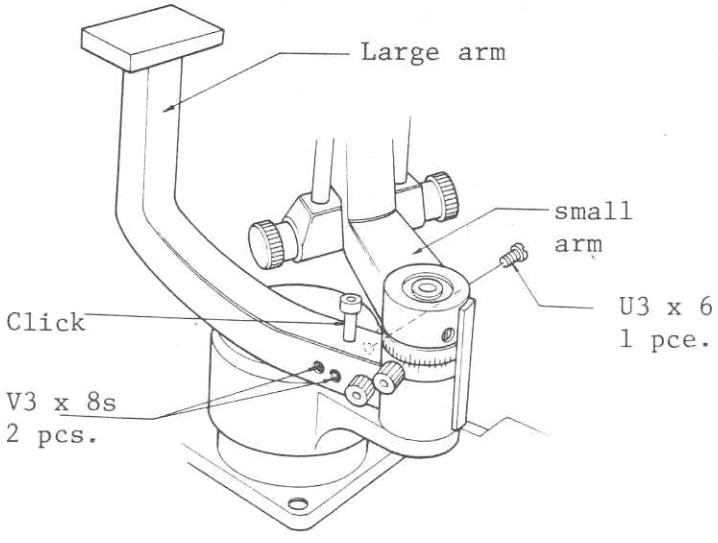
Sketch	Procedure
  [ϕ0.2 - within 0.03] [ϕ1, ϕ2 - within 0.1]	(3) Center setting of aperture and slit image If slit does not close evenly toward the center when the slit is shut at 0.2 ϕ slit size, 1) Adjust diopter with diopter adjusting ring by inserting eyepiece tool with scale into microscope unit. 2) Project 0.2 ϕ size slit on focusing rod, 3) Check amount of off-center by moving slit width adjusting knob, 4) Adjust slit unit by moving it left and right, up and down after 4 screws CR3 x 6s are loosened, 5) After completion, tighten screws securely. Note: Above adjustment should be accompanied by procedure(4) on next page.

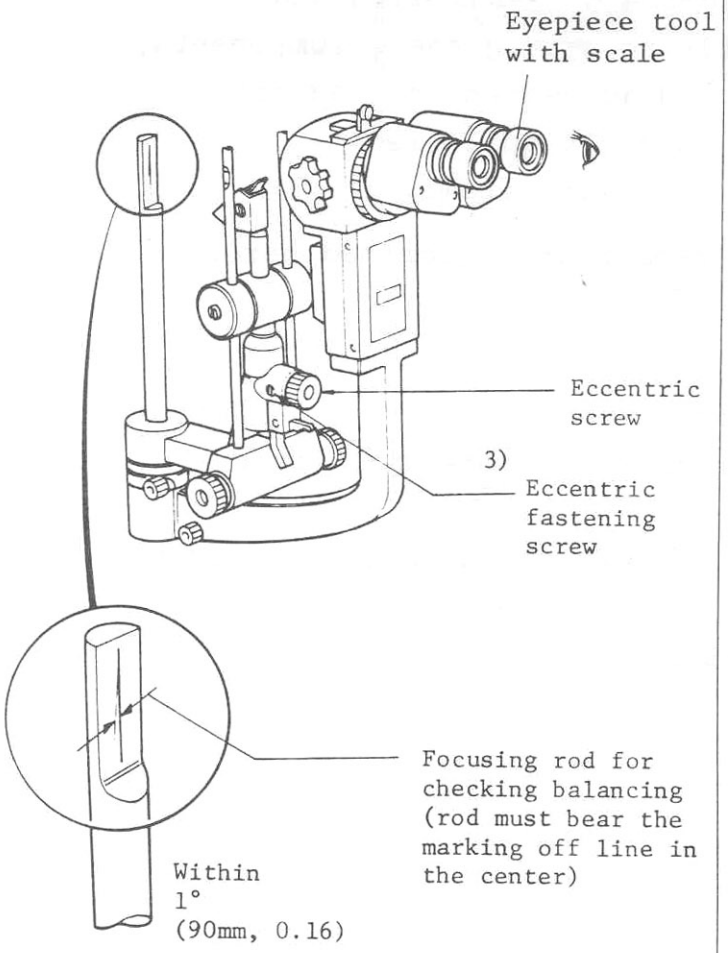
Sketch	Procedure
  Up down 0 Left and right within 0.1	(4) Slit image shift setting when rotating the slit image If rotational center of 0.2 ϕ moves, when slit rotation handle is moved, projecting 0.2 ϕ slit on slit rod screen; 1) Adjust diopter with diopter adjusting ring by inserting eyepiece tool with scale into microscope unit, 2) Project 0.2 ϕ slit on the focusing rod. 3) Check the amount of movement by turning slit rotation handle 180°. 4) Adjust eccentric axis (44630 2529) so as to effect up and down 0, left and right 0.1 by loosening screw V3 x 5s fixed on the head of aperture and filter unit. Note: Above adjustment should be accompanied by procedure (3) on the previous page.

Sketch	Procedure
	(5) Focus setting of slit image 1) Adjust diopter with diopter adjusting ring by inserting eyepiece tools with scale into microscope unit. 2) Project 9 ϕ size slit on the focusing rod, 3) Adjust focus by putting illumination objective lens frame (40310 2045) in and out after loosening 4 screws U3 x 3s. 4) Once focusing is made, tighten 4 screws U3 x 3s to lock them.

Sketch	Procedure
	(6) Slit image shift setting when rotating the slit illumination unit horizontally (30° to the left and right) 1) Adjust diopter with diopter adjusting ring by inserting eyepiece tool with scale into microscope unit. 2) Project 0.2 ϕ size slit on the focusing rod, 3) Watch deviations by moving illumination unit 30° each to left and right and adjust to hold the movement to the left and right within 0.1 by loosening 2 screws V3 x 8s of the mirror bracket. 4) After the adjustments, tighten screws and apply locktite.

Sketch	Procedure
	(7) Slit image shift setting when inclined 1) Adjust diopter with diopter adjusting ring by inserting eyepiece tool with scale into microscope unit. 2) Project 0.2 ϕ size slit on the focusing rod, 3) Watch volume of movement by moving inclination unit as shown by arrow, 4) Adjust mirror bracket screws (44630 2075); 2 of them V3 x 8s and also 2 U3 x 8s to ensure 0.2 ϕ centering. After adjustment, tighten screws and apply locktite.

Sketch	Procedure
	(8) Click power of small and large arms Adjust click power for ideal weight by tightening 2 screws V3 x 8s and 1 screw U3 x 6s. Note: When illumination arm is rotated, click stop should be felt firmly and securing the arm at the stop should be possible.

Sketch	Procedure
 Within 0.14 mm at 8mm slit length setting	(9) Inclination of slit image 1) Adjust diopter with diopter adjusting ring by inserting eyepiece tool with scale into microscope unit. 2) Project slit image after inserting focusing rod for checking balance (project the slit image as narrow as possible and secure at maximum length). 3) Adjust to hold falling within 1° with eccentric screw (44630 3516) after loosening eccentric fastening screw (44630 3512). after the completion of adjustments, tighten screws and apply locktite.

2.3 Repairing Order

Precautions for repairs

1. The following sections describe disassembling and assembling units. For correctly repairing these components, much experiences of assembly and adjustment of medical equipment are required. Only suitably qualified persons should carry out the following items.

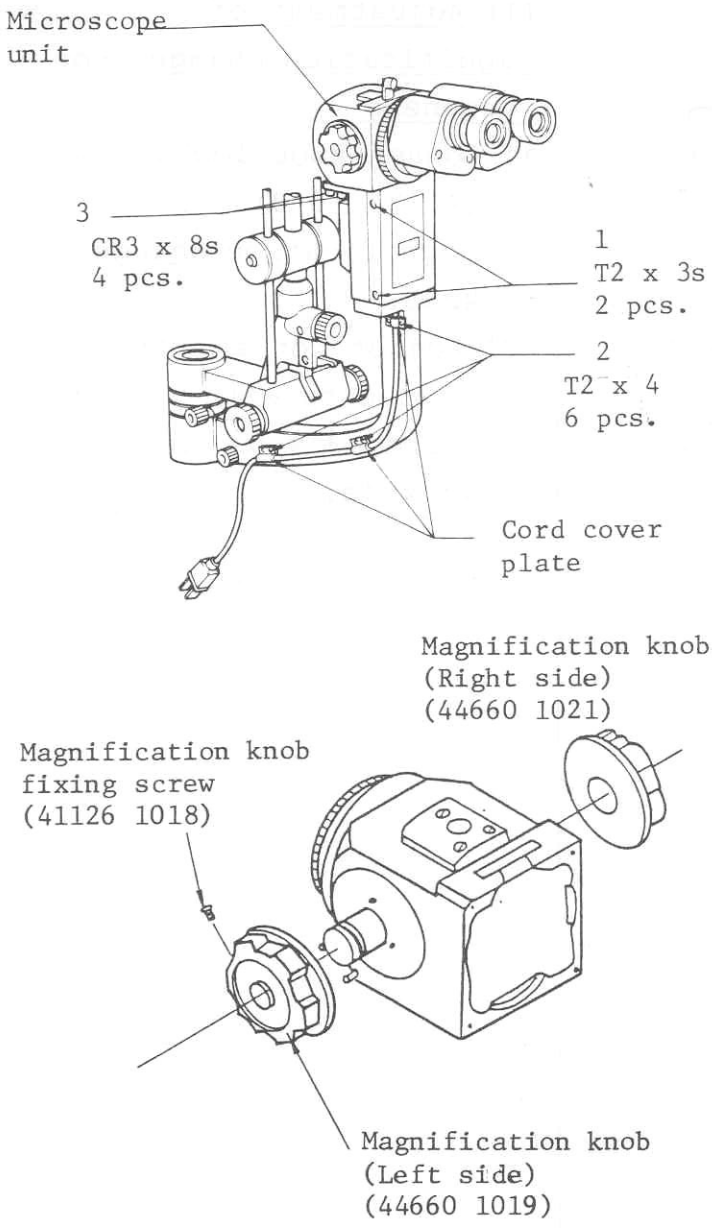
2. The special tools used in repair are described here. These are:

* White grinding stone
* Slit supporting platform

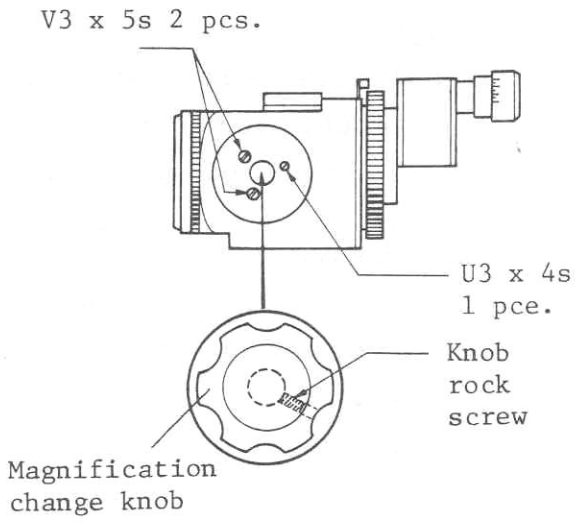
If these will be required for repairs, order them from TOPCON.

3. Before loosening screws, if locktite has been applied to the screws, dissolve it using amyl acetate. When retightening them after repair, apply fresh locktite.

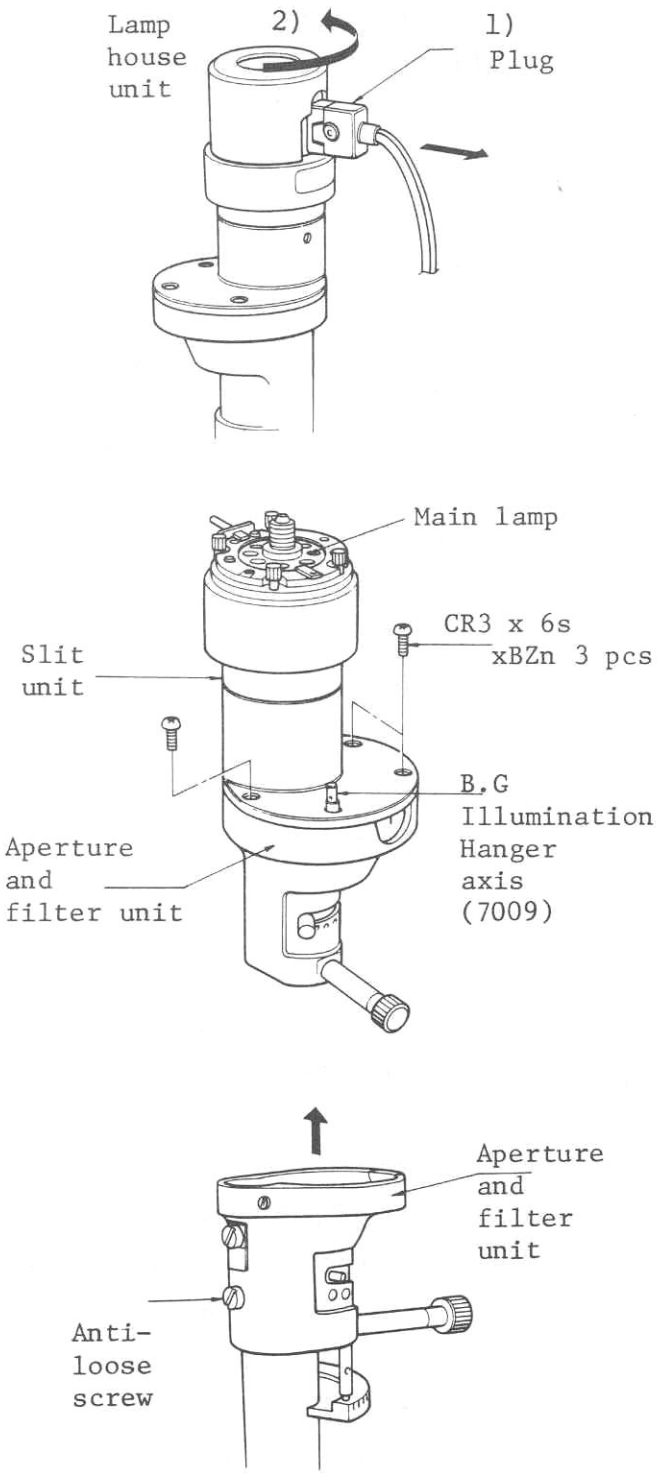
2.3.1 Disassembling Order of Microscope Unit

Sketch	Order
	(1) Removing microscope unit 1) Remove cord cover plate (44660 1031) by loosening 2 screws T2 x 3s. 2) Remove 2 cord covers (40350 3505) (3507) by loosening 6 screws T2 x 4s. 3) Remove microscope unit by loosening 4 screws CR3 x 8s. (2) Removing Magnification change knob Loosen magnification knob fixing screw (41126 1018) then pull the magnification knob until it is removed.

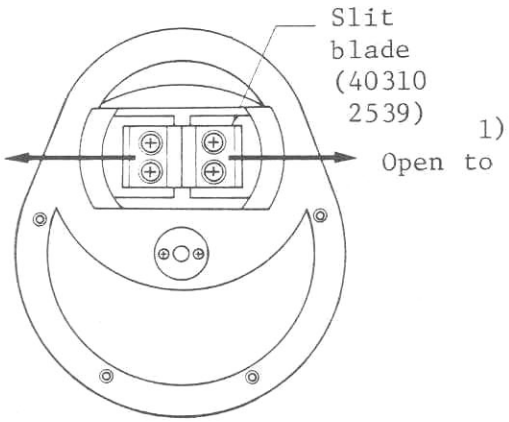
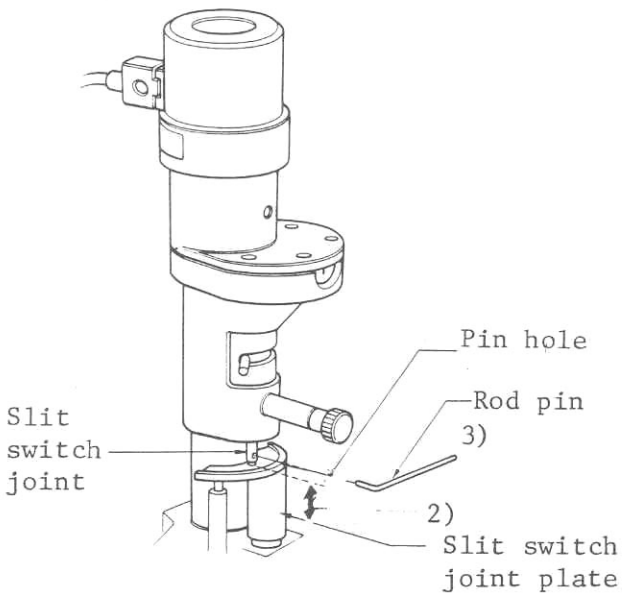
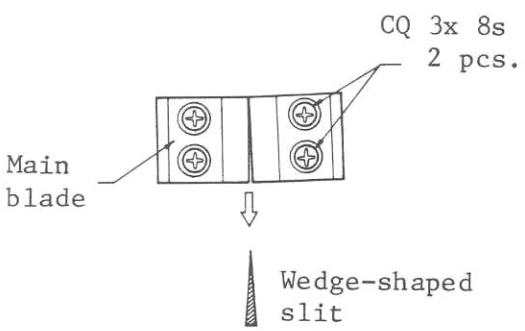
2.3.2 Critical points for assembling microscope unit

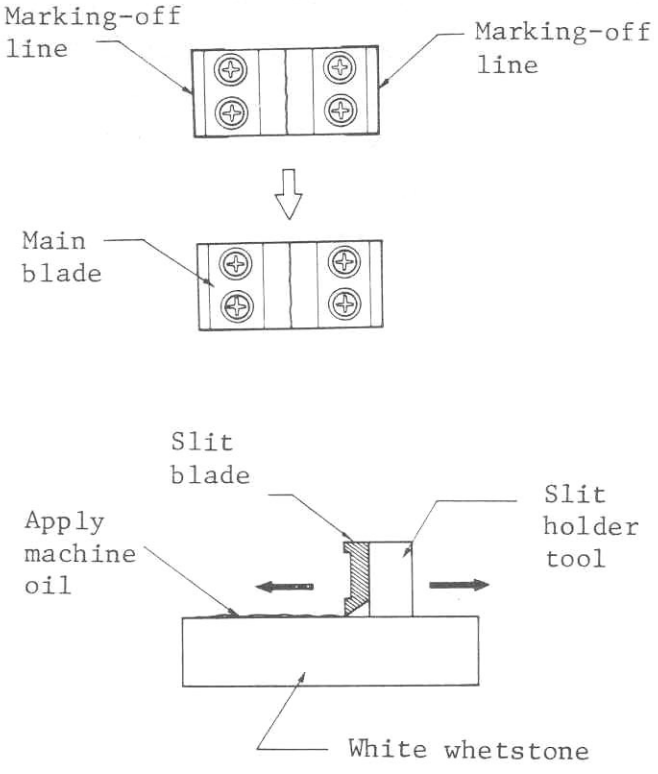
Sketch	Points
	(1) Adjustment of magnification change knob looseness 1) Loosen knob lockscrew (41126 1018) and remove magnification change knob. 2) Adjust for smooth movements with 3 screws; 2 are V3 x 5s and 1 is U3 x 4s.

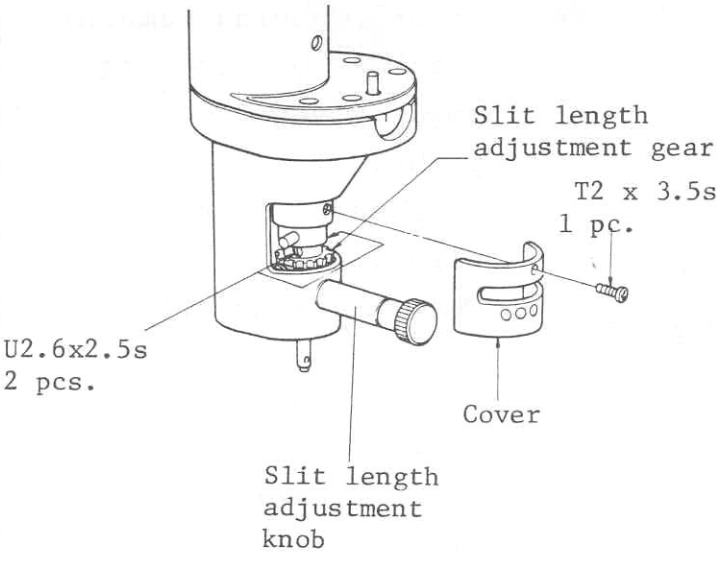
2.3.3 Disassembling order of Illumination Unit

Sketch	Points
	(1) Removing slit lamp unit 1) Disconnect plug of lamp house. 2) Remove lamp house by turning in arrow direction. 3) Remove main lamp. 4) Remove slit lamp unit by loosening 2 screws of B.G., illumination hanger shaft(7009) and 3 screws CR3 x 6S. 5) Pull slit lamp unit upward to remove it. (2) Removing aperture and filter unit 1) Loosen and remove screw T2 x 3.5S. 2) Remove filter handle cover (44630 2524). 3) Loosen 2 screws of u2.6 x 2.5s.

2.3.4 Critical points for assembling illumination unit

Sketch	Points
  	(1) Slit lamp unit Slit must always close on focusing rod. If it does not close check if any dust or foreign matter on slit. If free of foreign matter slit still does not close, then: 1) Check if return spring of slit blade works correctly (try moving it for opening directly by hand, both left and right) 2) Check if return spring of slit width control link works correctly (move the slit control link up and down). 3) Check if the slit control link and plate are tightly connected together. If these are loose, move rod pin up and down by turning it for adjustment. 4) In case of wedge-shaped slit blade, adjust it against the standard blade for complete closure by loosening 2 screws CQ3 x 8s. (Carry out such adjustment

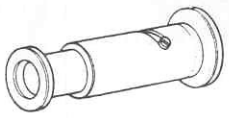
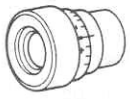
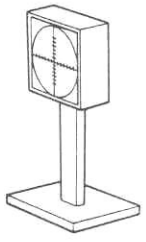
Sketch	Points
	after removing remaining locktite by applying amyl solvent to pinhead.) 5) In case of nicked slit blade: (a) Make marking-off lines prior to disassembling to ensure that the slit blade is set back into its correct position. (b) Use a screwdriver to remove both slit blades. (c) First whet main blade. A knock to whet it is to place slit blade flat on slit holder tool at a right angle and whet is smoothly on a lever. After whetting, remove burrs without fail and also wipe oil away completely for beautiful finish.

Sketch	Points
	(2) Unsmooth adjustment knob of slit length and filter unit In case of slit length adjustment knob being unsmooth adjust gear gaps to ensure smooth movements by loosening 1 screw T2 x 3.5s and lockscrew of slit length adjustment gear (40310 2518) after removing cover (44630 2524).

2.3.5 Cause and remedy for main possible trouble

Trouble	Cause	Remedy	Tool	
1. Slit does not close	Dust or any foreign matter adhering on slit.	Wipe off foreign matters using clothes moistened with solvent.	Eyepiece with scale	
	Slit is wedge-shaped.	Adjust of slit blade.	Eyepiece with scale	
2. 0.2 ϕ aperture	Accuracy in assembling is slit lamp unit and illumination is not	Carry out fine positioning after loosening 4 slit box fixing screws.	Standard scale and Eyepiece with scale	
3. Center of slit	The position of reflection mirror in illumination unit is incorrect.	Carry out fine positioning of mirror	Standard scale and Eyepiece with scale	

2.4 List of repair tools

Tool No.	Item	Illustration	Performance/ accuracy	Use	Remarks
[1]	Diopter telescope		Observation magnification 3.4 x	Same focusing by magnification	
[2]	Eyepiece tool with scale		Eyepiece magnification (10 x) Thickness of standard scale (0.02mm)	*Optical axis balancing left and right *Balancing of slit image *Changes of slit widths by slit image rotation *Image shift by pupillary distance adjustment	
[3]	Standard scale		Thickness of standard scale (0.02mm) With of 1 step (0.1mm)	*Image shift by magnification *Image shift by pupillary distance adjustment *Aperture and slit image deviations *Slit image shift by slit rotation *Slit image shift by inclination *Slit image shift when slit illumination unit is turned horizontally (30° to left and right)	
[4]	Focusing rod (with marking-off vertical line)			*Falling of slit image	

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